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Helium Pot System for Maintaining Sample Temperature after Cryocooler Deactivation

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A system for maintaining a sample at a constant temperature below 10K after deactivating the cooling source is demonstrated. In this system, the cooling source is a GM cryocooler that is joined with the sample through an adaptor that consists of a helium pot and a resistive medium. Upon deactivating the cryocooler, the power applied to a heater located on the sample side of the resistive medium is decreased gradually to maintain an appropriate temperature rise across the resistive medium as the helium pot warms. The temperature is held constant in this manner without the use of solid or liquid cryogens and without mechanically disconnecting the sample from the cooler.

Shutting off the cryocooler significantly reduces sample motion that results from vibration and expansion/contraction of the cold head housing. The reduction in motion permits certain processes that are very sensitive to sample position stability, but are not performed throughout the duration that the sample is at low-temperature.

An apparatus was constructed to demonstrate this technique using a 4K GM cryocooler. Experimental and theoretical predictions indicate that when the helium pot is pressurized to the working pressure of the cryocooler's helium supply, a sample with continuous heat dissipation of several-hundred milliwatts can be maintained at 7K for several minutes when using an extension that increases the cold head length by less than 50%.

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